Is a Drainable Wrap Enough?

Weather-resistive barriers and gaps

By Keith Lolley

The construction industry has seen a tremendous influx of new building materials over the past 10 years. Many of these products serve a real value, but with new offerings come new questions. Sometimes, innovation and evolution need to slow down and allow for proper training and education to catch up.

All building professionals will agree moisture is one of the leading factors in wall failures in both commercial and residential construction. There is still no cure for moisture intrusion, but there are ways to reduce the harmful resulting effects.

The big question, though is, 'how can builders build a drier wall?' The first step is to understand the proposed construction site's climate. After all, a building in Vancouver is far different from one in Whitehorse. When a site is chosen, professionals must consider the annual rainfall and snowfall, whether the area is in a high wind zone, and which type of cladding to use.

The Building Enclosure Moisture Management Institute (BEMMI), along with others, recommend that walls being built in areas receiving more than 508 mm (20 in.) of rainfall annually—Vancouver and Atlantic Canada fall into this category—have a drainage component, or capillary break.

The most commonly used cladding systems in construction today are brick, stucco, fibre cement, manufactured stone, metal, vinyl, wood (clapboards and cedar shingles), and glass. These claddings can be divided into two categories—absorptive and non-absorptive. Roughly 81 per cent of all cladding systems used today are absorptive. Therefore, these wall systems need to be constructed in order to allow moisture to drain and not linger behind the cladding.

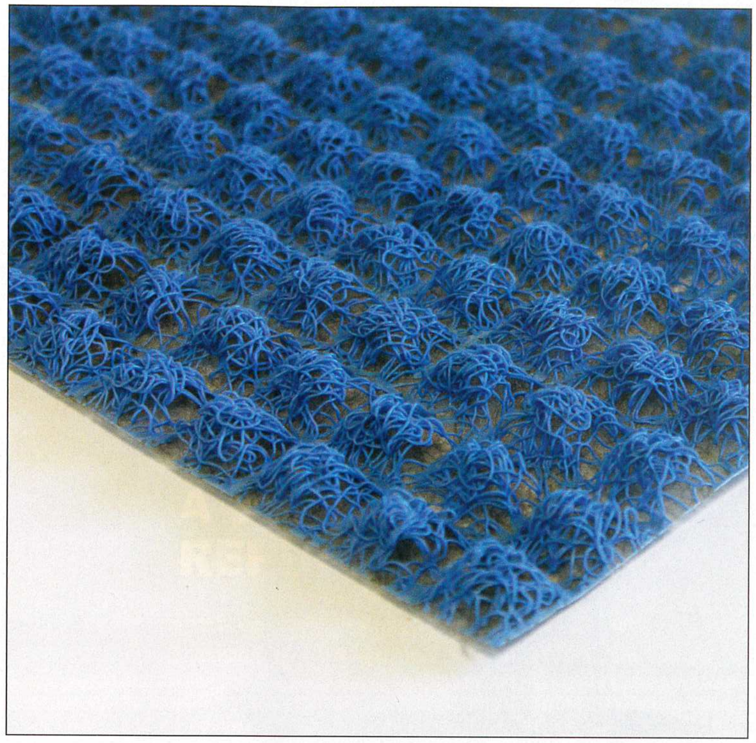
In older construction, this was not difficult to achieve. This author was recently on a restoration job from the 1940s. When the cladding was removed there were no signs of rot. One could see right through the sheathing as there were gaps in the joints. More air flowed through the structure than one could imagine, but that kept the wall dry for all those years.

Wall systems

Currently, there are three main wall systems:

- direct-applied;
- vented; and
- ventilated.

Direct-applied walls are typically constructed in this order, from interior to exterior: sheathing, weather-resistive barrier (WRB), window flashings, and then cladding. When moisture gets past the cladding it often remains trapped between the back of the cladding and the WRB's exterior side. What happens when the weather-resistive barrier is torn or not taped properly? The moisture takes the path of least resistance, often getting behind the WRB and into the sheathing. At this point, a moisture issue is inevitable.



An entangled matrix design can give moisture and air the ability to move in multiple directions for maximum ventilation and drainage.

Installing a polymeric-engineered rainscreen behind the cladding allows for proper draining and drying within the wall system.

A vented wall, also known as a cavity wall, is constructed in the following order—sheathing, flashings, WRBs, mortar deflection, and various absorptive claddings.

Commercially, one is seeing less and less concrete masonry unit (CMU) backup walls and more steel stud construction with various forms of sheathing. New energy codes call for increased outboard rigid foam insulation to maintain higher R-values and reduce energy costs. Air or vapour barriers, depending on the building's geographical location, greatly reduce the amount of moisture and air travelling through the building. Remember the 1940s restoration project that showed no sign of rot and how the structure had so many gaps in the sheathing for air to pass through easily? Air no longer has the ability to move through the wall with new construction technologies. To compensate, the wall system requires a gap, or capillary break.

Vented cavity wall designs, created for commercial assemblies, are designed to 'drain the rain.' This author thinks of such systems as 'reactionary walls.' They 'know' moisture is coming in, so they are designed to handle the problem by means of through wall flashings, mortar deflections, and weeps. These components allow moisture entering through the veneer a path to escape. Organizations such as the International Masonry Institute (IMI) recommend having a 50-mm (2-in.) air space. However, now there is an increase in outboard rigid foam insulation in these wall systems, so one of two things happen. The wall system is either becoming wider as design professionals retain the width of the gap, or the gap is being replaced with rigid foam insulation. The wider the wall, the more expensive it becomes. Further, the elimination of an air space causes the wall to become more susceptible to moisture.

Rainscreens

Specifying a ventilated rainscreen wall offers a means to keep the air space, increase the wall's performance, and shrink the overall assembly's dimensions. Unlike a vented cavity wall, ventilated rainscreen walls are designed to reduce the amount of moisture entering the building. These wall systems are designed to defend against moisture, not simply react to it.

The key to ventilated rainscreen wall systems is pressure moderation. If air pressure on the wall's inside is as close to equal with the air pressure on the outside of the wall, then the driving force pulling moisture through the cracks is greatly reduced in most claddings.

For this to work, these wall systems must be designed with an 'intake' and an 'exhaust.' One must allow air into the cavity mindfully. For example, we all know a 50-mm (2-in.) air space is twice as wide as a 25-mm (1-in.) air space. Therefore, twice as much air needs to enter the 50-mm air space when compared to the 25-mm space. This means it will take longer to neutralize the air space of a 50-mm cavity than a 25-mm cavity. The faster air pressure is neutralized the quicker it can combat moisture intrusion. Air should be allowed into the wall system by placing vents strategically at the wall's base and top. It is also recommended to have these vents at the bottom and top of every floor level, especially when the wall has been properly designed for fire blocking. This intake allows air to move in a convective-like fashion and exit through the top of the wall at the 'exhaust' locations. This circular movement continuously ventilates the wall by removing and not allowing a buildup of excessive moisture. For proper ventilation, the air space is recommended to be a minimum of 3 mm (0.11 in.).

An engineered polymeric drainage and ventilation mat is installed here with the filter fabric facing out as intended. The filter fabric acts as a mortar deflection blocking mortar from clogging the channel, while also not allowing the product to stretch and lose its intended air gap during construction.

The rainscreen for multiple sidings with entangled net drainage and ventilation mat has a heat bonded filter fabric attached to one side.

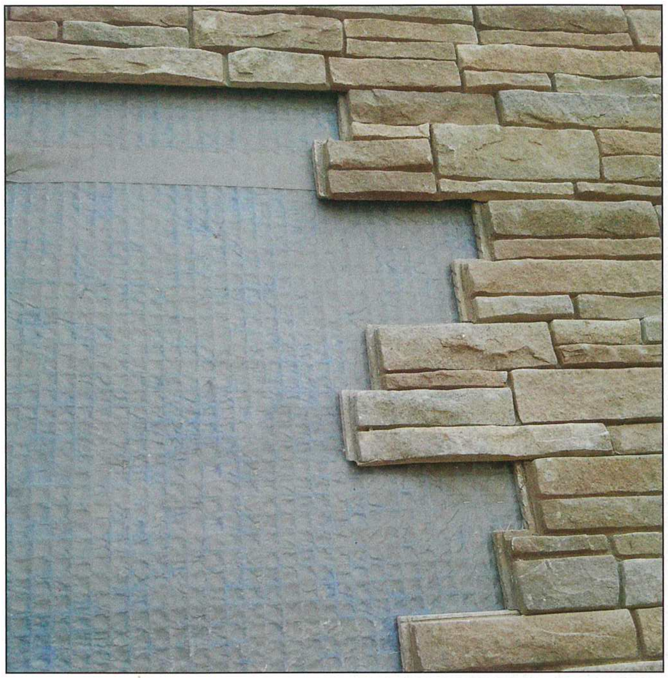
Forensic experts agree the key component to a successfully designed ventilated wall system is an air gap. So what is a sufficient air gap? Are two layers of Grade D paper enough? Is a drainable house wrap enough, or should an engineered polymeric drainage and ventilation mat, often referred to as a rainscreen, be used? Again, a few questions about building code, size of the gap, type of veneer being installed, and compatibility need to be asked.

According to Section 9.27.2.2 of the 2010 *National Building Code of Canada (NBC)*:

> ...exterior walls exposed to precipitation shall be protected against precipitation ingress by an exterior cladding assembly consisting of a first plane of protection and a second plane of protection incorporating a capillary break...
> ...a cladding assembly is deemed to have a capillary break between the cladding and the backing assembly where... there is a drained and vented air space not less than 10 mm deep (0.40 in.) 9.5 mm ($^{3}/_{8}$ in.) behind the cladding, over the full height and width of the wall...

The building code calls for a 10-mm (0.4-in.) air space, but what type of cladding is being used? If the cladding is absorptive, is it a masonry cladding? The drainage mat should have a filter fabric bonded to one side. In masonry walls, this allows the air space to remain clear of debris as well as provides a path for proper drainage and ventilation. The absence of a filter fabric allows excess mortar to clog the gap, which in turn creates a path for moisture to enter the inner wall system.

Building codes in the United States typically call for two layers of Grade D paper. Framers install the first layer when the walls are sheathed to protect the framing from wind-driven rain until the veneer is installed. The installer of the veneer typically installs the second layer of WRB. This additional layer is considered sacrificial for shedding liquid water away from the substrate. The second layer also creates a drainage space between the two. Another use for the sacrificial layer is to keep the first layer of Grade D paper dry during the scratch coat installation, which means moisture is not intended to penetrate the sacrificial layer.



This mixed-use building with businesses on the bottom floor and condos on the floors above in Atlantic Canada employs a 10-mm (0.4-in.) entangled matrix with a heat bonded filter fabric, which helps create a clear drainage and ventilation channel.

Drainable house wraps are the newest advancements in WRBs. These products either come with a crinkled design, or a 1-mm (0.04-in.) plastic bead to help create a gap for drainage. The drainage ability of these products far exceeds the typical house wraps that have been used for decades. This brings us to the question, "Is a drainable house wrap enough?"

The size of the air gap has been questioned. What is the correct space for proper drainage and ventilation? When creating a drainage and ventilation void space in residential construction, a 6.35-mm (¼-in.) gap is the standard in the United States. A 9.5-mm (3/8-in.) gap is recommended in Canada.

A common question for building professionals is, "Does a drainable house wrap create a great enough air space to be considered a ventilated rainscreen wall system?" The short answer is no.

For an air space to be effective, the gap must be a minimum of 3 mm (0.11 in.). To this author's knowledge, most drainable house wraps are not 3 mm (0.11 in.) thick. If used on their own with masonry veneer cladding, the scratch coat would clog the house wraps' drainable surface areas, leaving them rather ineffective. The author has witnessed many restoration projects using just a drainable house wrap with stucco and manufactured stone—the moisture was trapped. WRBs often tear during installation and are not taped properly at the seams.

Drainable house wraps, using a two-layer approach, will be effective for drainage, but not so much for ventilation when compared to a 6-mm (0.23-in.) rainscreen drainage and ventilation mat. On the other hand, if ventilation is

It is recommended to cut polymeric drainage and ventilation mats at corner locations. If wrapped around the corner incorrectly, there could be inconsistency when the cladding materials are installed.

not a concern and the cladding is wood, vinyl, or cement siding, then a drainable house wrap is often considered good enough.

Another option would be to install a WRB and an engineered polymeric drainage and ventilation mat. Here, builders would install the house wrap and instead of a sacrificial second layer, they would install the rainscreen mat as the second layer. The capillary break created by the rainscreen will substantially outperform the drainage ability of a drainable house wrap. For example, a typical drainable house wrap with 1-mm (0.04-in) spacers has a hydraulic transmissivity of 2.25E-04 m^2/s (0.11 gpm/ft) width, whereas a 6-mm (0.23-in.) engineered rainscreen has a hydraulic transmissivity of 8.67E-03 m^2/s (4.22 gpm/ft). This is a substantial difference, but for the sake of practicality, if a wall system needs to drain 15 L (4 gal) of moisture in a few minutes, it has to deal with bigger issues.

The biggest advantage to building with an engineered rainscreen is the air transmissivity. For example, the air transmissivity of a 6-mm (0.23-in.) engineered rainscreen is 1.51E-02 m^3/sec/metre width (9.8 ft) at an air gradient of 35; whereas, a drainable house wrap comes in at 4.85E-04 m^3/sec/metre width (0.03 ft) at the same air gradient. As mentioned, the ventilation aspect of a successful drywall is greater than the drainage ability. Walls only drain when it rains. Walls with proper ventilation continuously dry 24 hours a day, seven days a week.

Conclusion

When it comes to WRBs, a house wrap is good, a drainable house wrap is better, and an engineered polymeric drainage and ventilation mat is best. These engineered mats create a cavity wall concept without a true cavity wall cost when building with typical, direct-applied claddings. They block mortar from clogging the drainage plane due to the filter fabric bonded to the entangled net filaments. In ventilated cavity wall applications, these mats also allow the designer to increase the amount of outboard rigid foam insulation being used while still maintaining a proper drainage and ventilation gap without extending the wall's overall thickness. Engineered polymeric drainage and ventilation mats with a bonded filter fabric can be used with any absorptive cladding, which means they are a one SKU item for simple purchasing and inventory control, and can be used with any type of veneer.

Keith Lolley is the president of Advanced Building Products Inc. and also holds the position of chairman within the Building Enclosure Moisture Management Institute (BEMMI). Lolley has been involved in the moisture management end of the construction industry for the past 19 years. He can be reached at klolley@abp-1.com.